WATER QUALITY MONITORING ON BORON-DOPED DIAMOND ELECTRODES

Elizabeth A. McGaw, Prerna Sonthalia, and Greg M. Swain

Department of Chemistry, Michigan State University, East Lansing, MI 48824-1322

Keywords: Electroanalysis, Boron-Doped Diamond, Stripping Voltammetry, Metal

Abstract

On-board the International Space Station (ISS), potable water is used for drinking, food preparation, and hygiene. There are several potential sources of contamination, both organic as well as inorganic, that are potentially toxic to the crew. Several heavy metal ion contaminants have been recently detected in the ISS water (e.g. Ag(I), Pb(II), and Cd(II))[1]. The latter two were found at concentrations much higher than the EPA action levels. On-board monitoring of these contaminants is essential for crew health and safety. However, there is currently no system used for on-board water quality monitoring (organic and/or inorganic contaminants).

Electrochemical methods are attractive for use in environmental monitoring in space as they are versatile, energy efficient, easy to be automated, environmentally compatible, and cost effective. Traditionally, anodic stripping voltammetry (ASV) with a Hg electrode has been employed for trace metal ion analysis. Alternate electrodes, however, are being investigated because of the stability, toxicity, and volatility of Hg. Boron-doped diamond electrode has many advantageous properties, such as a wide working potential window, a low background current, and a reusable surface, that make it well suited as an alternative to Hg. Our group has shown that boron-doped diamond is a viable alternate electrode and can be used successfully for terrestrial ASV analysis of heavy metals found in water, sludge, and soil samples.[2]

Specifications for water quality monitoring on-board ISS will require additional modifications and optimization to the current assay. In this presentation, the effect of solution pH, dissolved oxygen, and salt content on the diamond electrode response (e.g., Ag(I), Cu(II), Pb(II), Cd(II) and Zn(II))will be presented. The results for diamond will be compared with the results for the state-of-the-art electrode, Hg.

References

1. Plumlee, D., Mudget, P.D., Schultz, J.R., "Chemical Sampling and Analysis of ISS Potable Water: Expeditions 1-3", *32nd International Conference on Environmental Systems*, San Antonio, TX, SAE Technical Paper, #2002-01-2537 (2002)
2. Sonthalia, P., McGaw, E., Swain, G.M., "Metal Ion Analysis in Contaminated Water Samples Using Anodic Stripping Voltammetry and a Nanocrystalline Diamond Thin-film Electrode", *Anal. Chim. Acta*, 522, 35 – 44 (2004)